QUEBECOR PRINTING ATGLEN INC.

CORRECTIVE MEASURES 90% DESIGN REPORT (INCLUDING COST ESTIMATE AND OPERATION & MAINTENANCE MANUAL)

APRIL 5, 1999

GES Groundwater & Environmental Services, Inc.

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In 1989, the United States Environmental Protection Agency (EPA) arranged for an independent contractor, NUS Corporation (NUS), to conduct an Environmental Priorities Initiative Preliminary Assessment of the site[1]. Based on existing site data and the preliminary assessment results, the EPA alleged that the site might pose an "imminent and substantial endangerment to health and the environment" as defined by Section 7003(a) of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6973. On 5 June 1991, Quebecor Printing Atglen Inc. (Quebecor) voluntarily entered into a Section 7003 Administrative Order by Consent (Consent Order).

In response, a RCRA Facility Investigation (RFI) was conducted at the site in accordance with the EPA-approved RFI Work Plan. The EPA approved the RFI Report (dated 7 February 1994) on 25 March 1994. A Corrective Measures Study was conducted by Groundwater & Environmental Services, Inc. (GES),dated 17 August 1994, and approved by the EPA on 29 September 1994. The site plan **(Figure 1)** shows the three separate areas of concern: the Tank Field Area, the Railroad Siding Area, and the Line Leak Area.

1.1 TANK FIELD AREA

On 27 September 1985, separate-phase solvent was detected in monitoring well MW-1E, one of two groundwater monitoring wells that had been installed near the facility's underground storage tank (UST) field. A groundwater sample collected from monitoring well MW-1E contained separate-phase solvent that was consistent in composition to "Lactol". Monitoring well MW-1E was pumped for 48 hours and the fluid was containerized in drums. Laboratory analysis of a water sample collected from monitoring well MW-2E, located 75 feet east of the tank field, indicated a dissolved solvent concentration below the analytical detection limit of 2 parts per billion (ppb), as reported on the Incident Report prepared by the facility and submitted to the Pennsylvania Department of Environmental Protection (PADEP) on 9 October 1985.

Subsequent investigations by Environmental Resources Management, Inc. (ERM) included pressure-testing the underground solvent storage tank system and conducting a subsurface contamination assessment of the site. The eight solvent tanks were pressure tested by the Leak Lokater LD2000 precision test method (October 1985); all eight tanks passed within the acceptable limits of the testing procedure. The associated underground piping also passed the test. ERM also installed seven monitoring wells (MW-1 through MW-7) near the solvent tank field during the preliminary hydrogeologic investigation. These monitoring wells were constructed of two-inch diameter polyvinyl chloride (PVC) well casing and screen; the screens were placed to intercept the water table. Well completion depths ranged from 23 to 25 feet below grade.

Following the initial investigation by ERM, indicating that both dissolved- and separate-phase hydrocarbons existed beneath the site, Groundwater & Environmental Services (GES) installed a recovery and treatment system adjacent to the Tank Field Area in 1986. The system pumped

[1] *"Environmental Priorities Initiative Preliminary Assessment of Diversified Printing Corporation" prepared under TDD No. F3-8904-11, EPA No. PA-2538, Contract No. 68-01-7346, for the Hazardous Site Control Division U.S. Environmental Protection Agency, 23 October 1989, by NUS Corporation Superfund Division.*

groundwater and separate-phase solvent (SPS) from a recovery well (RW-1) and treated the recovered fluids by passing them through an air stripper tower and a granular activated carbon polish unit. Treated water from this system, which operated continuously from 1986 through 1998, was discharged to a drainage swale under NPDES permit number PA0054933. Two additional monitoring wells (MW-8 and MW-9) were also installed to a depth of 30 feet to provide additional plume definition. Approximately 3,700 gallons of separate-phase solvent were recovered in the first three months of remedial system operation. Approximately 5,300 gallons of SPS have been recovered through July 1994 from the remedial system operation. In addition, dissolved-phase has been recovered by recovery well RW-1 since system installation, with an average withdrawal rate of 1,440 gallons per day.

The system was deactivated in October 1998 to facilitate the removal of underground storage tanks that were located near the system. In October and November 1998, the eight USTs and associated piping were removed from the ground and disposed offsite. In conjunction with the UST removal, approximately 700 tons of solvent-impacted soil were excavated and disposed offsite.

1.2 RAILROAD SIDING AREA

On 26 November 1988, an accidental surface release of 3,500 to 6,000 gallons of solvent occurred at the vapor recovery unit located in the northwest corner of the building. Due to a mechanical malfunction, solvent overflowed from a recovery tank, spilled onto the floor, and discharged through a floor drain to the railroad spur just north of the building. The spilled solvent rapidly migrated through the building's perimeter storm drain network and into a marshy area west of the building and was then carried by a small stream into a pond adjacent to the south side of Lower Valley Road. Response measures were immediately implemented to recover as much solvent as possible.

Quebecor subsequently instituted initial corrective measures in response to this surface spill, including extensive emergency response activities and subsequent restoration of pond and stream biota through controlled, gradual introduction. The emergency response activities, summarized in a 24 March 1989 letter in the Administrative Record, included liquid vacuum extraction from the storm drains and marsh, soil trenching and investigation, pond aeration, pond monitoring and sampling, and domestic well sampling. In addition, measures were implemented at the plant to prevent reoccurrence of similar events, as detailed in the incident report submitted to PADEP (included in the Administrative Record). The pond and marsh areas were restored completely to pre-release conditions.

Five monitoring wells (wells S-1 through S-5) and recovery well RW-2 were installed in early 1989 in the area of the surface release; construction details of these wells are included in the RCRA Facility Investigation (RFI) Workplan. Well completion depths for S-1 through S-5 ranged from 16 to 21 feet below grade. RW-2 was connected to the existing groundwater treatment system by underground piping and a holding tank. Recovery from RW-2 also needed to be discontinued in October 1998. ?

1.3 LINE LEAK AREA

On 31 October 1993, Quebecor personnel discovered a ruptured underground line discharging toluene-based solvent to the subsurface resulting in a washout of the soil directly above the rupture and release of solvent to the surface and subsurface. At the time of release confirmation, plant officials notified the PADEP. Quebecor was responsible for initial efforts to remove the leaking line from service, control and abate the surface spill, and remove separate-phase solvent from the subsurface via a hand-dug pit.

On 1 November 1992, Quebecor contacted GES to further investigate and remediate the spill. Initial efforts utilized a series of shallow test borings, designed to delineate the bounds of saturated subsurface material and recover SPS. All of the borings indicated a similar lithology: six inches of macadam, underlain by 12 to 16 inches of crushed stone, overlying native silty clay. The crushed stone beneath the macadam was identified as a zone of high permeability, allowing water to collect. Since the crushed stone overlies the low-permeability clay, a perched water table was formed. When solvent was released, much of the solvent collected on top of this perched water, between the macadam and the native soil.

Additional solvent collection efforts included the installation of a sump and two groundwater interception trenches. Four test holes were used to extract subsurface volatile organic compound (VOC) vapors via a vapor extraction and recovery unit (VR unit).

Additional investigation work also included:

- The installation of six test pits along the solvent transfer line;
- Installation of groundwater monitoring wells MW-21 and MW-22 (abandoned and replaced with MW-22A to protect against the possibility of aquifer cross-contamination);
- A subsurface soil quality investigation (via Geoprobe borings);
- Groundwater sampling; and
- Additional vapor recovery testing.

Note that between the occurrence of the Line Leak Area release in 1993 and November 1995, investigative activities in the Line Leak Area were conducted under the guidance of PADEP. Beginning in November 1995, PADEP, EPA, and Quebecor agreed that EPA would be lead agency for corrective action in the Line Leak Area. An interim measures workplan, specifically developed for the Line Leak Area, was developed by GES (dated 28 June 1996) and submitted to USEPA.

1.4 RCRA FACILITY INVESTIGATION REPORT

A RCRA Facility Investigation (RFI) was initiated upon approval of the RFI Workplan on 22 July 1992. The RFI entailed the collection of physical and chemical data to determine the nature and extent of releases of hazardous material or constituents from regulated units, solid waste management units, and other potential source areas at the facility.

Elements of the RFI included a soil gas survey; surface water and stream sediment sampling; the installation of eight shallow monitoring wells (MW-10 to MW-18) and three deep monitoring wells (MW-11D, MW-14D, and MW-15D); two rounds of groundwater sampling from all non-solvent bearing wells installed before the RFI and once from all wells installed during the RFI; rising-head slug tests performed on six shallow monitoring wells; 48-hour groundwater pumping tests at the three deep monitoring wells; and a Method-of-Characteristics (MOC) groundwater model to evaluate potential movement of dissolved benzene, ethylbenzene, xylenes, toluene, and bis(2-ethylhexyl)phthalate in groundwater at the site. As part of the RFI, a baseline human health-based risk assessment was also performed at the Quebecor facility for each area of concern.

Site soil conditions primarily consist of saprolitic clay, generally 20 to 40 feet thick, overlying pinnacled limestone. Groundwater occurs in the unconsolidated overburden at a depth of approximately 7 to 9 feet below grade. The generalized groundwater flow direction is consistently toward the southwest.

A final RCRA Facility Investigation Report was completed for the site and submitted to EPA on 7 February 1994. The RFI demonstrated that two areas of concern at the facility had been affected: the Tank Field Area, located on the east end of the main facility building, and the Railroad Siding Area, located near the northwestern corner of the building. Data collected from the soil gas survey, soil borings, surface water and sediment sampling, and water samples collected from both shallow and deep monitoring wells defined both the lateral and vertical extent of impact in the unconsolidated overburden and groundwater. The EPA approved the RFI on 25 March 1994. In 1995, the Line Leak Area was also added as an area of concern.

1.5 REMEDIATION SYSTEM

A groundwater recovery system was active at the facility from 1986 through October 1998. The remediation system recovered groundwater and separate-phase solvent through two recovery wells, RW-1 (installed in 1986 in the Tank Field Area) and RW-2 (installed in 1989 in the Railroad Siding Area). The air-stripping tower (constructed in 1986) treated recovered groundwater with secondary water treatment by granular activated carbon (GAC) filtration (added in 1993). Approximately 5,300 gallons of solvent have been recovered by this remediation system, although solvent recovery rates have decreased significantly since 1994, suggesting decreasing volumes of solvent in the subsurface.

The air stripper tower and RW-1 were located immediately adjacent to the UST Area. During the UST removal and associated excavation of solvent-impacted soil, it was necessary to deactivate the remedial system. RW-1 was completely destroyed during the soil excavation activities.

SECTION 2.0
CORRECTIVE MEASURE DESIGN PLANS AND SPECIFICATIONS

2.1 CORRECTIVE MEASURE DESIGN STRATEGY

The finalized remediation goals for this site are outlined in the EPA-issued Final Decision (FD) dated 16 June 1997, and Final Consent Order (FCO) which became effective in April 1998. These documents define EPA expectations of overall remediation; acceptable soil and groundwater cleanup standards; and allowable end points for the discontinuance of remedial action.

The basis for terminating active remediation will be dependent upon the remedial progress attained relative to the performance requirements and cleanup standards defined in the FD and FCO. The specific Media Cleanup Standards, which will be used as a basis for system termination and site closure, are summarized below:

Soil Cleanup Standards

Compound of Concern	Concentration (ppm)
Benzene	n/a
Toluene	100.0
Ethylbenzene	70.0
Xylene	1,000.0
DEHP	n/a
PCE	n/a

Groundwater Cleanup Standards

Compound of Concern	Concentration (ppm)
Benzene	0.005
Toluene	1.0
Ethylbenzene	n/a
Xylene	n/a
DEHP	0.006
PCE	0.005

During system operation, groundwater will be monitored quarterly at 10 Point of Compliance (POC) monitoring wells, and biannually at 10 POC monitoring wells plus 8 additional wells, selected to monitor the progress of remediation. Per stipulations of the Final Consent Order, analysis of chemicals PCE and DEHP may be discontinued if data is gathered to suggest these chemicals are not present at the site. Trig 1

Following the termination of active remediation in each area of concern (active remediation will continue for a minimum of three years), biannual groundwater quality monitoring in compliance-monitoring wells shall continue for a minimum of two years to confirm Media Cleanup Standards attainment. If, after a minimum of three years of active remediation, it is determined that attaining Media Cleanup Standards is technically impractical for a specific area, well, and/or chemical of concern, a modification of one or more of the Media Cleanup Standards will be requested for that area, well, and/or chemical of concern as provided for in the FD and FCO. 5 yr

Specific to impacted soils, GES will initiate a program to collect confirmatory soil samples with a Geoprobe® following the completion of soil remediation in any of the three specific areas of concern. The confirmatory soil-sampling program will be based directly on current Pennsylvania Department of Environmental Protection Act II Regulations, denoted as the "75/10 Rule". This regulation states that a representative number of samples must be collected from the area of original impact, following the completion of remediation. For originally impacted soil totaling up to 125 cubic yards, eight samples must be collected. For originally impacted soil totaling between 125 and 3,000 cubic yards, 12 samples must be collected.

The collected soil samples will be analyzed for toluene, ethylbenzene, and total xylenes (TEX). If the concentrations of T, E, and X are below USEPA mandated soil cleanup standards in at least 75% of the collected samples, and no single sample exceeds cleanup standards by greater than 10 times, then remediation will be considered complete in that specific area.

Text on the application of the 75/10 Rule for each specific area to be remediated is also included in Sections 3.1.1, 3.1.2, and 3.1.3 of the Project Management Plan.

After attainment of the remediation goals or demonstration of Technical Impracticability, GES will prepare a project closure report for submittal to regulatory agencies. The following subsections summarize the remedial goals for each area, and general requirements necessary to complete remediation.

2.1.1 Tank Field Area

Note: Removal of underground storage tanks, impacted soil, and back filling of the UST excavations was completed between the date of the Corrective Measures 50% Design Report (dated 29 April 1998) and the submittal of the Corrective Measures 90% Design Report. The following text accurately reflects the work already completed.

- Underground storage tanks (USTs) and adjacent, impacted soils were removed in accordance with the Quebecor UST Removal Sampling Plan (dated 7 July 1994) and stipulations in the Site Sampling Plan (Section 3.8.2). Excavated soils not requiring off-site disposal were stockpiled on plastic sheeting near the excavations and soil samples were collected for laboratory analysis. Soils requiring off-site disposal were loaded directly into trucks for transportation to an approved hazardous waste disposal facility.

- Tanks were removed in two individual phases. Phase 1 entailed the removal of the four southern tanks and impacted soils. Phase 2 entailed removal of the four northern tanks and impacted soil. Stockpiled soil containing concentrations of chemicals of concern below USEPA limits (as determined by laboratory analytical data) and as defined in correspondence dated 13 November 1998 (**See Attachment 1 in the Project Management Plan**), were utilized as backfill.

- An UST Closure Report was completed in accordance with PADEP UST regulations and filed with PADEP. A copy of the report was also submitted to USEPA.

- Proper disposal of all USTs was completed. UST disposal documentation was provided in the UST Closure Report.

- Soils impacted above Media Cleanup Standards were removed to ensure that impacted soils do not continue to impact groundwater. Approximately 700 tons of soil was removed. Manifests for all soil disposal were included with the UST Closure Report.

- Since not all impacted soil could be removed due to encroachment on adjacent buildings and roadways, limited areas of impacted soil remaining in place will be remediated via high-vacuum, total phase extraction (HVTPE).

- Install six new recovery wells and collect pre-remediation soil samples.

- Install a high-vacuum, total phase extraction (HVTPE) system within this area, capable of remediating adsorbed-phase solvents in the soils (via soil vapor extraction) and dissolved-phase solvents in groundwater (via groundwater recovery).

- A design summary of the HVTPE system to remediate the dissolved chemicals of concern in groundwater and adsorbed chemicals in soils is included with this report.

After the completion of remediation in the Tank Field Area (i.e., completion of soil remediation via HVTPE), the following will be completed:

- Implement post-remediation sampling for chemicals of concern to demonstrate attainment of remedial goals or modified remedial goals, as defined in the FD and FCO. Remediation will be deemed complete in this area after meeting any of the closure criteria stated and defined in the FD and FCO.

- Specific to demonstration of cleanup standards for soils, eight to twelve soil samples will be collected with a Geoprobe®. Samples will be collected and analyzed via USEPA methodology SW846/5035/8021B for TEX. Analytical results will be interpreted via the 75/10 methodology. In summary, if the concentrations of T, E, and X are below USEPA mandated soil cleanup standards in at least 75% of the collected samples and no single sample exceeds cleanup standards by greater than 10 times, then soil remediation will be considered complete in that specific area. The exact locations of the soil samples will be determined following the completion of remediation. 7.

- In the case that confirmatory soil samples show that cleanup goals have not been met, then additional HVTPE shall be completed in all or selected portions of the former Tank Field Area.

- When remediation is completed per conditions stated in the FD and FCO, closure will obtained for this area.

2.1.2 Railroad Siding Area

- Install nine new recovery wells and collect pre-remediation soil samples.

- Install a high-vacuum, total phase extraction (HVTPE) system within this area, capable of remediating adsorbed-phase solvents in the soils (via soil vapor extraction) and dissolved-phase solvents in groundwater (via groundwater recovery).

After the completion of remediation, the following will be completed:

- Implement post-remediation sampling for chemicals of concern to demonstrate attainment of remedial goals or modified remedial goals, as defined in the FD and FCO.

Remediation will be deemed complete in this area after meeting any of the closure criteria stated and defined in the FD and FCO.

- Specific to demonstration of cleanup standards for soils, eight to twelve soil samples will be collected with a Geoprobe®. Samples will be collected and analyzed via USEPA methodology SW846/5035/8021B for TEX. Analytical results will be interpreted via the 75/10 methodology. In summary, if the concentrations of T, E, and X are below USEPA mandated soil cleanup standards in at least 75% of the collected samples and no single sample exceeds cleanup standards by greater than 10 times, then soil remediation will be considered complete in that specific area. The exact locations of the soil samples will be determined following the completion of remediation.

- In the case that confirmatory soil samples show that cleanup goals have not been met, then additional HVTPE shall be completed in all or selected portions of the Rail Road Siding Area.

- When remediation is completed per conditions stated in the FD and FCO, closure will obtained for this area.

2.1.3 Line Leak Area

- Install ten new recovery wells and collect pre-remediation soil samples.

- Install a HVTPE system within this area, capable of remediating adsorbed-phase solvents in the soils (via soil vapor extraction) and dissolved-phase solvents in groundwater (via groundwater recovery).

After the completion of remediation, the following will be completed:

- Implement post-remediation sampling for chemicals of concern to demonstrate attainment of remedial goals or modified remedial goals, as defined in the FD and FCO. Remediation will be deemed complete in this area after meeting any of the closure criteria stated and defined in the FD and FCO.

- Specific to demonstration of cleanup standards for soils, eight to twelve soil samples will be collected with a Geoprobe®. Samples will be collected and analyzed via USEPA methodology SW846/5035/8021B for TEX. Analytical results will be interpreted via the 75/10 methodology. In summary, if the concentrations of T, E, and X are below USEPA mandated soil cleanup standards in at least 75% of the collected samples and no single sample exceeds cleanup standards by greater than 10 times, then soil remediation will be considered complete in that specific area. The exact locations of the soil samples will be determined following the completion of remediation.

- In the case that confirmatory soil samples show that cleanup goals have not been met, then additional HVTPE shall be completed in all or selected portions of the Line Leak Area.

- When remediation is completed per conditions stated in the FD and FCO, closure will obtained for this area.

2.2 CORRECTIVE MEASURE DESIGN BASIS

All data collected throughout the RCRA process and associated investigations were reviewed to determine the most appropriate conceptual designs of the remediation technologies to be installed at the Quebecor facility. This includes soil and groundwater quality data, pump and slug test data, and soil physical parameter data collected during the RFI (completed by GES, dated 17 August 1994), investigative work completed in the Line Leak Area (completed by GES and included in the Line Leak Area Interim Measures Workplan, dated 26 June 1996), and remedial options and pilot tests considered in the Corrective Measures Study (completed by GES, dated 29 September 1994). Also, soil investigation activities completed with a Geoprobe® on 29 June and 22 July 1998 in the Tank Field Area and post-excavation soil sampling results collected during UST removal activities have been added to the data base utilized to complete final system designs. Results of the 29 June and 22 July sampling event are included as in the Project Management Plan (Revision 1) dated February 4, 1999. A UST post-excavation soil sampling data is also included in the Project Management Plan.

The remedial strategy has been designed in accordance with current environmental and public health standards. Design calculations and reference material, historical pilot test and slug test data, and equipment manufacturer's specifications are provided in **Appendix A.** This design report provides the outline of the approach to design, install, and operate the following remediation systems, which were selected as the most efficient and effective means to fulfill the remediation requirements of the facility's FCO:

- HVTPE for remediation of soil and groundwater at the Railroad Siding Area.
- HVTPE for remediation of soil and groundwater at the Line Leak Area.
- Tank removal and soil excavation activities followed by HVTPE at the Tank Field Area. HVTPE will be completed only in specific areas where impacted soil was left in place following UST removal and impacted soil excavation.

The attached remediation system engineering drawings include the following:

- **Figure 1 -** Generalized Site Plan
- **Figure 2 -** Site Plan: Tank Field and Line Leak Areas
- **Figure 3 -** Site Plan: Railroad Siding Area
- **Figure 4 -** Piping & Instrumentation Diagram Legend
- **Figure 5 -** Piping & Instrumentation Diagram: HVTPE Recovery System
- **Figure 6 -** Piping & Instrumentation Diagram: Groundwater Recovery and Treatment System
- **Figure 7 -** HVTPE Recovery Well Piping & Vault Details (Railroad Siding Area)
- **Figure 8 -** HVTPE Recovery Well Piping & Vault Details (Line Leak and Tank Field Areas)
- **Figure 9 -** Equipment Compound Details

GES will provide system start-up and operation and maintenance as detailed within the operation and maintenance section of this report.

2.2.1 High-Vacuum, Total-Phase Extraction (HVTPE) – Railroad Siding and Line Leak Areas

The HVTPE system will use 15 recovery wells in the Railroad Siding Area, and 10 recovery wells in the Line Leak Area to extract groundwater, soil vapors, and SPS through a PVC drop pipe. The drop pipe is installed at each HVTPE recovery well to a predetermined depth below the water table and is connected to a high-vacuum blower through a subsurface piping network. The blower produces a high vacuum (up to 28 inches mercury [Hg] maximum) at each HVTPE well. Details of the HVTPE wells and trench locations are indicated on **Figure 2 and 3.**

The high vacuum which is created at the bottom of the drop pipe removes groundwater, soil vapors, and SPS (if present) from the HVTPE well. Soil vapors are drawn through the exposed soil profile region (including the previously saturated soils). The vapor, which is pulled through the soil profile, removes solvent vapors from the unsaturated soil pore spaces while drawing in clean air from the surface. This process promotes the volatilization of solvents from the impacted soil and increases the amount of oxygen within the subsurface, encouraging natural biodegradation of chemical constituents. HVTPE enhances the recovery of groundwater and SPS due to the high vacuum that increases the pressure gradient towards the HVTPE well. This design will utilize three vacuum blowers of Liquid Ring Pump (LRP) design in which LRP-1 will be connected to 8 recovery wells in the Rail Road Siding Area, LRP-2 will be connected to 7 wells in the Rail Road Siding Area, and LRP-3 will be located to 10 recovery wells in the Line Leak Area.

Under static (non-vacuum) conditions, SPS and groundwater recovery is dependent upon the ability of the solvent to travel into the recovery well from a high-pressure area within the capillary fringe, to a lower pressure area in the recovery well. When a vacuum is exerted on a recovery well in conjunction with total fluid recovery, the SPS is pulled through the soil pores toward the extraction well via the applied vacuum. Therefore, the vacuum creates the pressure gradient towards the extraction well that displaces the residual soil pressure (which, under non-vacuum conditions, tends to keep the product from mobilizing) along the capillary fringe. This vacuum-enhanced recovery process occurs during HVTPE operation.

A HVTPE system will have the following advantages:

- More aggressive source removal due to the additional wells within the solvent plume (resulting in decreased time until area remediation is accomplished).

- The combination of vapor extraction and groundwater recovery via one blower is much more efficient than utilizing separate pumps and blowers. Trenching and piping is simplified because HVTPE piping networks usually are designed with main header pipes which branch off to individual wells, thereby reducing the number of pipes and conduit required in system trenches.

2.2.2 Excavation and HVTPE – Tank Field Area

> **Note: Removal of underground storage tanks, impacted soil, and back filling of the UST excavations was completed between the date of the Corrective Measures 50% Design Report (dated 29 April 1998) and the submittal of the Corrective Measures 90% Design Report. The following text accurately reflects the work already completed and also summarizes additional measures intended to remediate impacted soils left in place in the vicinity of the former USTs.**

Excavation was an effective means to remove solvent-impacted source areas (i.e., SPS and adsorbed-phase solvents) in the vicinity of the USTs in the Tank Field Area. The removal of SPS and adsorbed-solvent source areas will assist in the reduction of dissolved-phase solvent concentrations in groundwater.

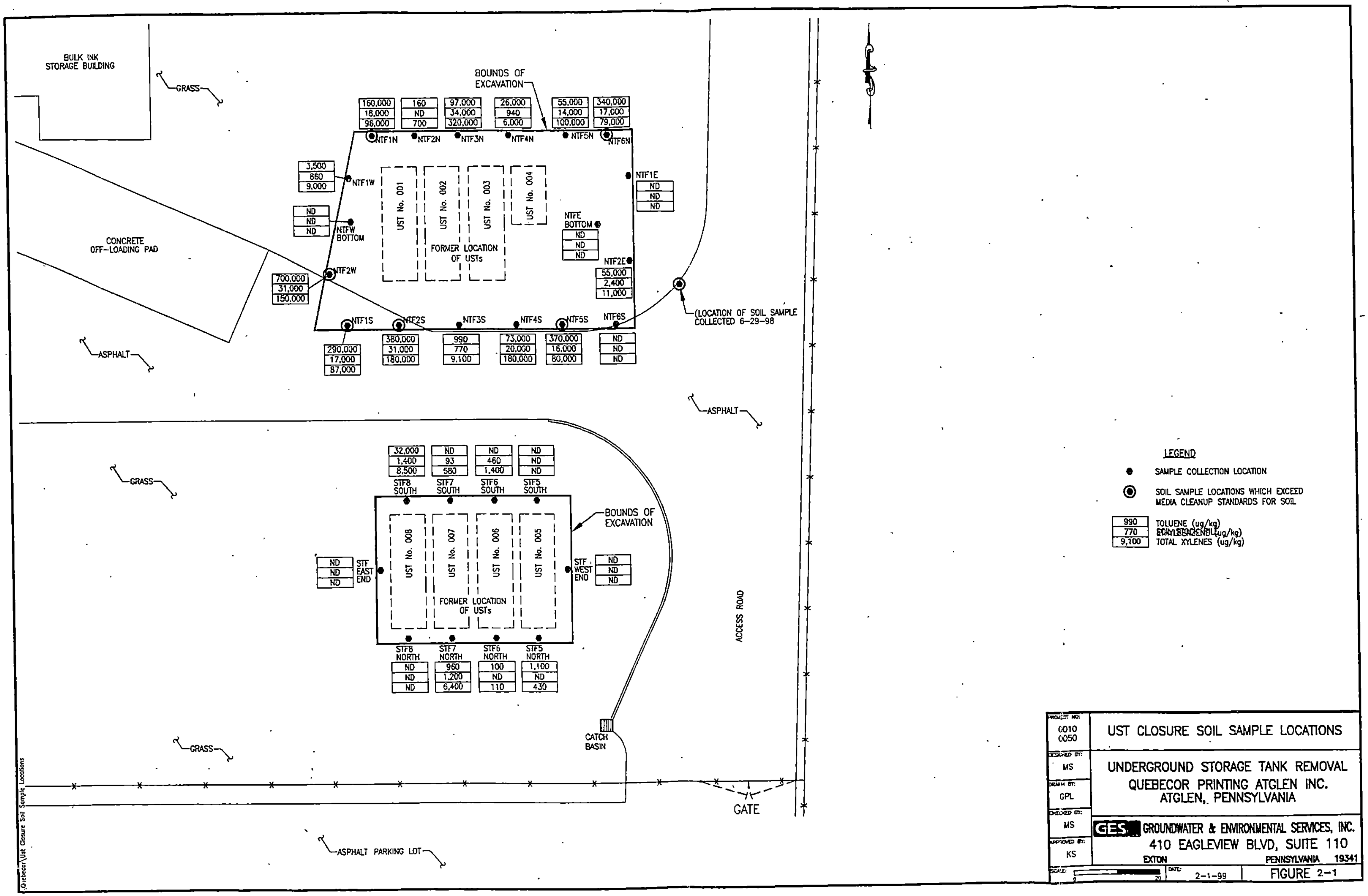
As detailed in Section 3.2 of the 50% Design Report, the eight USTs were removed in two phases. Phase one entailed the removal of the four USTs in the Southern Tank Field, soil sampling, backfilling, and instillation of a temporary roadway above the former location of the Southern Tank Field. Laboratory results of post excavation soil sampling from the Southern Tank Field Area showed that concentrations of chemicals of concern in all soil samples were below Media Cleanup Standards. Therefor, no over excavation of soil or disposal of impacted soil took place as part of Phase I.

Phase 2 entailed the removal of the four USTs in the Northern Tank Field, excavation of impacted soil, soil sampling and backfilling. Strategic excavation was conducted to remove the maximum amount of impacted soil. The removal of known source areas was controlled by data collected during the completion of two Geoprobe® investigations undertaken on 29 June and 22 July 1998 (see **Appendix 2**).

Post-excavation soil samples gathered after the completion of UST removal and final soil excavation have shown that limited areas of impacted soils were left in place surrounding the location of the former northern tanks. Post excavation soil samples indicate that five specific areas surrounding the Northern Tank Field contain soils impacted with chemicals of concern above USEPA-mandated limits (**Figure 2-1**). A sixth area, located approximately 30 feet east of the Northern Tank Field Area (discovered during the 29 June and 22 July Geoprobe® investigations) also contains soils impacted above USEPA-mandated limits.

Because impacted soils were left in place, GES proposes to complete direct *insitu* remediation via HVTPE on remaining impacted soils to meet the Consent Order Media Cleanup Standards.

As noted to USEPA in correspondence dated 20 November 1998, GES stated that the majority of the solvent impacted source material (approximately 700 tons) was removed. We also noted that although additional excavation is an option, the bounds of the excavation and the financial considerations associated with additional soil removal have become limiting factors. Specifically, additional excavation toward the north and west in the Northern Tank Field Area was difficult due to existing structures. Excavation toward the south was possible; however, based on the existing concentrations in soil, the volume of soil requiring additional excavation was not cost effective. Based on the current understanding of the site and historical site information and communications with USEPA, the following strategy is designed to provide effective remediation to remaining impact in the vicinity of the northern Tank Field Area.


BULK INK STORAGE BUILDING
GRASS
CONCRETE OFF-LOADING PAD
ASPHALT
BOUNDS OF EXCAVATION
160,000 18,000 96,000 NTF1N
160 ND 700 NTF2N
97,000 34,000 320,000 NTF3N
26,000 940 6,000 NTF4N
55,000 14,000 100,000 NTF5N
340,000 17,000 79,000 NTF6N
3,500 860 9,000 NTF1W
ND ND ND NTFW BOTTOM
700,000 31,000 150,000 NTF2W
NTF1E ND ND ND
NTFE BOTTOM ND ND ND
NTF2E 55,000 2,400 11,000
UST No. 001
UST No. 002
UST No. 003
UST No. 004
FORMER LOCATION OF USTs
NTF1S 290,000 17,000 87,000
NTF2S 380,000 31,000 180,000
NTF3S 990 770 9,100
NTF4S 73,000 20,000 180,000
NTF5S 370,000 16,000 80,000
NTF6S ND ND ND
(LOCATION OF SOIL SAMPLE COLLECTED 6-29-98
ASPHALT
GRASS
32,000 1,400 8,500 STF8 SOUTH
ND 93 580 STF7 SOUTH
ND 460 1,400 STF6 SOUTH
ND ND ND STF5 SOUTH
BOUNDS OF EXCAVATION
ND ND ND STF EAST END
STF WEST END ND ND ND
UST No. 008
UST No. 007
UST No. 006
UST No. 005
FORMER LOCATION OF USTs
STF8 NORTH ND ND ND
STF7 NORTH 960 1,200 6,400
STF6 NORTH 100 ND 110
STF5 NORTH 1,100 ND 430
ACCESS ROAD
CATCH BASIN
GRASS
GATE
ASPHALT PARKING LOT
LEGEND
SAMPLE COLLECTION LOCATION
SOIL SAMPLE LOCATIONS WHICH EXCEED MEDIA CLEANUP STANDARDS FOR SOIL
990 TOLUENE (ug/kg)
770 ETHYLBENZENE (ug/kg)
9,100 TOTAL XYLENES (ug/kg)
PROJECT NO: 0010 0050
UST CLOSURE SOIL SAMPLE LOCATIONS
DESIGNED BY: MS
DRAWN BY: GPL
CHECKED BY: MS
APPROVED BY: KS
UNDERGROUND STORAGE TANK REMOVAL
QUEBECOR PRINTING ATGLEN INC.
ATGLEN, PENNSYLVANIA
GES GROUNDWATER & ENVIRONMENTAL SERVICES, INC.
410 EAGLEVIEW BLVD, SUITE 110
EXTON PENNSYLVANIA 19341
SCALE: 0 20
DATE: 2-1-99
FIGURE 2-1
Quebecor\Ust Closure Soil Sample Locations

Installation of One Groundwater Well

GES has installed one six-inch diameter monitoring well (RS-1) in the downgradient corner of the NTF Area (**Figure 2**). The purpose of this monitoring well will be to assess dissolved concentrations in groundwater. This well will also be utilized as a temporary extraction point for groundwater pumping prior to the installation of the final remedial system.

As noted in 50% Design submittal, the installation of two wells was previously proposed for the Tank Field Area for use as groundwater recovery wells with the Corrective Measures remediation system. Since GES intends to use six high-vacuum total-phase extraction (HVTPE) wells in the vicinity of the NTF to manage impacted soils left in place following UST removal, the utilization of the two groundwater recovery sumps will not be necessary to meet the Consent Order goals for remediation.

Installation of Six High-Vacuum Total-Phase Extraction (HVTPE) Wells

In order to manage remediation of in-place soils, GES will install six, four-inch diameter HVTPE wells (**Figure 2**). The six HVTPE wells will be designed and plumbed so a high vacuum can be applied to the well heads. The high vacuum can effectively extract soil vapors from the impacted soils while also enhancing groundwater recovery. This strategy has been approved by USEPA to treat impacted soils at two other locations on this facility property. This approach is a viable and effective option of treating soils and groundwater in the vicinity of the UST Area. Based on the conservative well spacing identified for the six HVTPE wells, the utilization of these wells will provide adequate hydraulic control while remediating adsorbed solvent impact.

Note that pilot tests completed at the facility show that vacuum extraction radius of influence ranges from 15 feet to 38 feet. The HVTPE well layout illustrated on **Figure 2** has been designed using an effective radius-of-influence of 18 feet. This conservative estimate has been used for design purposes only, and the actual radius of influence is expected to be much greater.

The HVTPE system in the Tank Field Area, consisting of six HVTPE points to be installed following UST and impacted soil excavation, will be capable of reducing dissolved-phase concentrations in groundwater and adsorbed-phase concentrations in soils to Media Cleanup Standards. The respective HVTPE recovery wells will be installed in the areas where soil impact is known to remain.

During the backfilling of the UST tank excavation, GES provided engineering measures to reduce the potential for the proposed HVTPE recovery system to short-circuit through pea gravel backfill material. These measures included the installation of an impermeable liner above pea gravel backfill at a depth of 6.5 feet below grade within the UST excavation, and utilizing low-permeability native soil backfill above the impermeable liner. Since the water table fluctuates from depths of 7 to 10 feet below grade, the amount of unsaturated pea gravel in the tank field excavation ranges from 0.5 to 3.5 feet. Due to the presence of the impermeable liner and the low permeability of the backfill compacted above the liner, the vertical movement of vapor in the tank field excavation will be minimal. Therefore, the proposed vapor recovery system in the tank field area will not be significantly affected by short-circuiting through the excavation area.

Additionally, GES intends to install the new vapor recovery wells at least 10 feet from the excavation (therefore, short-circuited vapors would have to be pulled through a minimum of 10 feet of low-permeability native soil). Previous vapor recovery tests had indicated that an effective radius-of-influence at the subject property extends up to 30 feet. Since a vapor recovery radius-of-influence of only 15 to 18 feet would appropriately remediate adsorbed solvent impact in the vicinity of the tank field area, the vapor recovery wells will be spaced conservatively enough to provide effective remediation even if some short-circuiting occurs.

The engineering measures described above will minimize the risk of significant short-circuiting and will provide the necessary radius-of-influence to remediate the adsorbed solvent impact. The locations of the six HVTPE points and the proposed trenching locations are shown on **Figure 2.**

2.3 CORRECTIVE MEASURE DESIGN DETAILS

A HVTPE equipment container (to house soil vapor/groundwater recovery equipment) will be installed between the Line Leak Area and the Railroad Siding Area to provide centralized equipment for soil vapors and groundwater extraction from the three areas of concern, significantly reducing the complexity of the overall remediation system. Centralized groundwater treatment equipment will also be housed in the equipment container **(Figure 9).** Centralized soil vapor treatment equipment will be located outside of the equipment container.

A total of 31 HVTPE wells (15 in the Railroad Siding Area, 10 in the Line Leak Area, and 6 in the Tank Field Area) will be plumbed to three high-vacuum blowers located in the equipment container. Most HVTPE piping and conduit will be installed within sub-grade trenches, with the remaining portion installed as aboveground piping. The proposed sub-grade-trenching network will range in width from 2 to 3 feet, and in depth from 3 to 4 feet. Recovery wells located within the Railroad Siding enclosure (recovery wells RW-2, RW-7, RW-8, RW-9, RW-11, and S-3) will manifold via aboveground piping in an effort to minimize disruptions in the vicinity of the railroad spur. The HVTPE piping will consist of a series of 3-inch, 4-inch, or 6-inch header pipes that reduce to 2-inch pipes manifolded to each extraction well. Each HVTPE header will be manifolded to up to 13 extraction wells.

At any one time, a total of 20 of the 31 HVTPE recovery wells (10 of 15 Railroad Siding Area wells; 7 of 10 Line Leak Area wells and 3 of 6 Tank Field Area wells) will be utilized for extraction. As system operating parameters and groundwater quality data are obtained and evaluated, the HVTPE and groundwater recovery systems will be adjusted to maximize solvent recovery rates in impacted areas. Any area where HVTPE remediation is found to be complete can be taken off-line by rerouting the vacuum and vapor flow that was used for previously operating wells and apply it to remaining, more-impacted areas. This is an important "pulsing" aspect of the system since the most-impacted areas can be remediated more aggressively as other areas are cleaned.

2.3.1 Tank Field Area

2.3.1.1 Tank Removal and Soil Excavtion

GES has completed strategic excavation to remove the majority of impacted soils and will complete additional remediation of remaining, inplace impacted soils with HVTPE in the Tank Field Area for the following reasons:

- Excavation resulted in the most efficient removal of the majority of source material,
- Excavtion plus HVTPE remediation is predicted to be the most effective means to accomplish the goal of remediation in the shortest operational period, and

- Groundwater and vapor treatment equipment for the Line Leak and Railroad Siding Areas can be utilized to treat recovered groundwater and vapors from the Tank Field Area.

As stipulated in the Final Consent Order for the facility, EPA is lead agency on soil and groundwater remediation issues at the tank field; however, PADEP will be lead agency on administrative issues related to the UST removal, including Notification of Removal forms, completion of a Closure Report and sampling of soils for closure. Previously, the PADEP reviewed and approved a GES-developed UST Removal Sampling Plan, dated 7 July 1994. For clarification, the plan requires the following elements:

- During UST excavation, all removed soils were to be screened with an organic vapor monitor (OVM) for the presence of total organic vapors. Grossly impacted soils (defined as soils saturated with product or soils with an OVM reading greater than 1,000 units) were to be loaded into trucks and immediately removed from the site for disposal.
- After removal of USTs from each of the two tank fields, one soil sample was to be collected from each wall of each excavation (for a total of eight samples).
- Samples were to be collected at the soil water interface.
- Samples were to be analyzed for TEX via EPA Method 5035/8021B.

During UST removal, GES completed this sampling protocol, as approved. However, it is understood that this sampling protocol may have been insufficient to provide data to show that the soil Media Cleanup Standards presented on Table 1 of the USEPA Final Decision were met.

In order to supply the necessary soil quality data, GES added the following elements to the sampling plan:

- Soils not classified as grossly impacted were stockpiled on plastic sheeting next to the excavation. Following completion of excavation activities, stockpiled soils were sampled and analyzed for TEX via EPA Method SW846 - 5035/8021B.
- After removal of USTs from each of the two tank fields, a minimum of ten soil samples were collected from each excavation at the soil water interface. Samples were analyzed for TEX via USEPA Method SW846 - 5035/8021B.
- Following collection of the soil samples, they were submitted for 24-hour laboratory analysis. Upon receipt of analytical data, additional excavation was completed at the locations where analytical results exceeded soil cleanup standards. Following excavation, additional confirmatory soil samples were collected and analyzed for TEX via USEPA Method SW846 - 5035/8021B.
- This process continued until concentrations of chemicals of concern in soil were below Media Cleanup Standards or until the excavation encroached into areas critical for plant access or near foundations of adjacent structures. Since excavation activities extended beyond the anticipated bounds of impact and further excavation was unfeasible, provisions for including a soil remediation system in the tank field area will be required.
- All samples were analyzed for TEX via EPA Method 846 -5035/8021B.
- All analytical results from soil stockpile samples contained concentrations of TEX below USEPA-mandated levels; therefor, the soil was utilized as backfill in the UST excavations.

As presented, this approach will complete remediation of the Tank Field Area in three distinct phases:

(1) Removal of existing USTs. This task was completed in November 1998.

(2) Removal of the majority of soils impacted at concentrations above the Media Cleanup Standards in the immediate vicinity of the USTs (approximately 700 tons of solvent-impacted soil was removed and transported off site for disposal during November 1998) followed by post excavation soil sampling, and

(3) Recovery well installation and remediation of remaining impacted soil and groundwater via HVTPE.

2.3.1.2 Tank-Anchoring Slab

In March 1998, Quebecor located as-built drawings for the existing facility Tank Fields. Prior to location of the drawings, Quebecor and GES were unaware of the UST construction details. Most notably, the information on the as-built drawings shows that the USTs were located on and anchored to a continuous, 30 foot by 40 foot by 1-foot thick reinforced concrete slab (one slab per tank field). Per the drawings, the concrete slabs are shown to extend to 11.5 feet below grade.

GES left the concrete slab in place following removal of underground storage tanks for the following reasons:

- The concrete slab beneath both the northern and southern tank fields were found to be in excellent condition at the time of UST removal. They were not cracked or compromised. Therefor, the slabs are assumed to be generally impermeable and will significantly limit the downward migrations of chemicals of concern in the area of the former USTs.
- Soil quality samples collected in the Northern Tank Field from below the elevation of the concrete slabs (i.e., past the edges of the slab) contained nondetect concentrations of chemicals of concern.

2.3.1.3 Waste Classification and Sub-Slab Soil Sampling

Prior to UST removal, (June 29 and 22 July 1998) GES utilized a Geoprobe® to collect soil samples from twenty different locations surrounding the two tank fields. The purpose of the samples were to further investigate the bounds of soil impact and complete the laboratory analysis necessary for waste disposal classification in advance of any excavation of soils in the Tankfield Area.

GES collected and analyzed the soil samples for waste disposal parameters and to gain pre-approval for waste disposal at an approved facility prior to the commencement of excavation. This process allowed excavated soils from the UST area to be loaded directly into dump trucks and transported offsite on the same day of excavation, thus eliminating the need to store hazardous soils in on-site roll-off containers.

To determine soil quality beneath the concrete slabs underlying the USTs, GES collected soil samples from approximately 12 feet to 14 feet below grade, concurrent with the soil preclassification sampling. The samples were collected as close to the edge of the USTs as possible (and as close to the concrete slabs) without risking damage to the in-place tanks. However, no attempt was made to penetrate the slabs. The 12 to 14 foot samples were for the specific purpose of assessing soil quality beneath the depth of the concrete slab.

A workplan to complete the above-described Geoprobe® activities, dated 22 June 1998 was submitted to USEPA for review and approval (see the Project Management Plan, dated February 4, 1999). The workplan was approved by USEPA and Geoprobe® soil sampling activities were completed on 29 June and 22 July 1998.

2.3.1.4 Backfilling and Tankfield System Installation

The two excavated UST tank fields were backfilled with a combination of native soil removed during excavation (but determined to contain concentrations of chemicals of concern below Health-based Standards) and 3/8" pea gravel. During back filling operations, the pea gravel was installed first, to a level of approximately 6.5 feet below grade. Following installation of the pea gravel in the Northern Tankfield (only), an impermeable geo-textile membrane was installed on top of the pea gravel. Finally, clean, native soil was installed in the excavation and brought to grade.

Permission to utilize the clean, excavated soil as backfill was granted by both USEPA and PADEP. Correspondence documenting permission to utilize the native soil as fill is included as an attachment of the Project Management Plan. All procedures to sample stockpiled soil was completed via agreement with USEPA.

The concrete slabs underlying both tank fields were not removed.

Laboratory analytical results of post-excavation soil sampling collected as part of the Southern Tank Field removal activities showed that soils surrounding the southern USTs did not contain concentrations of chemicals of concern above Media Cleanup Standards. Therefor, no additional remedial activities will be completed in the Southern Tank Field Area.

Post excavation soil samples from the Northern Tank Field Area showed that impacted soil was left in place following UST removal. Therefor, soil and groundwater remediation will be completed in this area via HVTPE. The HVTPE system in the Northern Tank Field Area will consist of six HVTPE wells designated RW-24 through RW-29. Trenches will be excavated for the placement of vapor/groundwater conveyance piping between the wells and the extraction equipment located in the transfer compound.

Soil vapors and groundwater will be extracted from the six extraction wells in the Northern Tank Field Area via a centralized high-vacuum blower. The blower for this area will also manifold into six HVTPE wells in the Railroad Siding Area. The blower will be capable of recovering 96 scfm of air at a vacuum of 21 inches of mercury. Recovered soil vapors and total fluids will be separated in the recovery/groundwater treatment compound. The recovery compound will house the high-vacuum blowers, knockout tanks, transfer pumps, and oil/water separator. Recovered groundwater will be pumped through an air stripper and carbon polishing prior to storm sewer discharge. Soil vapors will be directed to vapor-phase carbon units located outside of the compound.

2.3.1.5 UST Closure Report

The complete removal of USTs and excavation of soil at this facility was completed between the submittal of the Corrective Measures 50% Design Report (dated 29 April 1998) and the Corrective Measures 90% Design Report.

The final UST Closure Report, summarizing the removal activities, was submitted to PADEP on 26 January 1999. A copy of the UST Closure Report (without attachments) is included as an attachment in the Project Management Plan. Correspondence from Pennsylvania Department of Environmental Protection, dated 3 March 1999 notes that the UST Closure Report was reviewed by PADEP and accepted.

2.3.2 Railroad Siding Area

In the Railroad Siding Area, existing soil-quality and groundwater-quality data suggest that the majority of adsorbed-phase and separate-phase solvent impact is located between recovery well RW-2 and monitoring well MW-10. Pilot testing data completed in this area and summarized in the Corrective Measures Study indicate that groundwater recovery and soil vapor extraction (via HVTPE) will provide the most aggressive and effective remediation of solvent-impacted soil and groundwater.

Data from vapor extraction pilot testing in the railroad siding and tank field areas indicate that a vapor extraction radius-of-influence of 15 to 38 feet will be observed. In order to aggressively remediate the impacted soil and groundwater, GES will utilize recovery wells (located approximately 30 feet apart) throughout the impacted area. Proposed recovery well locations are indicated on **Figure 3**. A well spacing of 30 feet corresponds to a radius-of-influence of 15 feet. A total of 9 proposed wells (RW-5, RW-6, RW-7, RW-8, RW-9, RW-10, RW-11, RW-12, and RW-13) and 6 existing wells (MW-10, RW-2, RW-3, RW-4, S-3, and S-1) will be connected to the recovery system.

Trenches will be excavated for the placement of vapor/groundwater conveyance piping between the wells and the extraction equipment located in the transfer compound. Trench locations are shown on **Figure 3**. Existing and proposed recovery wells located within the Railroad Siding and in close proximity to the railroad tracks (RW-2, RW-7, RW-8, RW-9, RW-11, S-1, and S-3), will be connected to remediation equipment via above-ground piping prior to transitioning to below-ground piping. All above ground piping will be heat wrapped to avoid freezing.

Soil vapors and groundwater will be extracted from the 15 extraction wells in the Railroad Siding area via two high-vacuum blowers. The six HVTPE wells from the tank field area will also manifold to one of these two blowers. The two blowers specified for this application are capable of removing a respective total of 90 and 96 scfm of air at a vacuum of 21 inches of mercury.

Recovered soil vapors and total fluids will be separated in the equipment container. The equipment container will house the high-vacuum blowers, knockout tanks, transfer pumps, and oil/water separator. Recovered groundwater will be pumped through an air stripper and carbon polishing prior to storm sewer discharge. Soil vapors will be directed to vapor-phase carbon units, located outside of the compound.

2.3.3 Line Leak Area

Historical soil and groundwater quality data from the Line Leak Area indicate that soil impact may extend to a depth of 12 feet below grade. In order to remediate the adsorbed solvent mass, which is the source of elevated dissolved-phase solvent concentrations, the water table will need to be lowered to expose currently-saturated soils for vapor-phase recovery. Since groundwater recovery yields are low in this area, a HVTPE system will provide an effective and aggressive remediation approach for soil vapor and groundwater recovery. A HVTPE system within the Line Leak Area combined with the HVTPE system at the Railroad Siding Area will result in reduced capital equipment costs and operation and maintenance costs.

Soil vapors and groundwater will be recovered from ten recovery wells located within the Line Leak Area (spaced 30 to 35 feet apart). Proposed well locations are indicated on **Figure 2.** Based on this well spacing, a minimal radius-of-influence of 15 feet will be required to remediate the impacted area. One high-vacuum blower will be used to recover soil vapor and groundwater from the ten HVTPE wells. The blower, located in the equipment container, will be capable of 91 scfm flow rate at a vacuum of 21 inches of mercury. This allows the extracted total-phase stream from the Line Leak Area to be routed through the common separation, pumping, and treatment equipment.

2.4 STATUS OF INTERIM REMEDIATION SYSTEM

The original site groundwater recovery and treatment system for recovery well RW-1 continued to operate until shortly before UST excavation activities commenced at the northern tank field area (November 1998). At that time, it was necessary to deactivate the remedial system in order to facilitate UST removal. Additionally, UST excavation activities led to the destruction of recovery well RW-1.

Following tank field backfilling activities, one new recovery sump (RS-1) was installed in the Northern Tank Field Area for the propose of assessing groundwater quality and completing interim groundwater extraction, prior to the construction of the final site remedial system. It is anticipated that recovery sump RS-1, situated in close proximity to existing recovery well RW-1, will be used on a short-term basis to recover groundwater. The existing electrical power supply will be re-routed to recovery sump RS-1 to allow for the installation of groundwater recovery and solvent recovery pumps.

The interim groundwater pumping system (RS-1) will utilize pumps and controls from the original RW-1 system; however, the original air stripper treatment system will not be utilized. During the interim system operation, the submersible groundwater pump will recover groundwater from recovery sump RS-1 at a flow rate similar to the original system (1 gpm). Two liquid-phase GAC units will be utilized to treat the groundwater during the operation of the interim pumping system. The two GAC units will be sized appropriately based on the influent flow rate and TEX concentration. The existing effluent discharge pipe will be connected to the interim system and the existing discharge permit requirements will be followed.

It is anticipated that well RW-2 (also a part of the original site remedial system) will be reactivated. As RW-2 was previously utilized, recovered groundwater will be pumped to a holding tank located near the well. When the tank is full, the water will be pumped from the tank and treated through the granular activated carbon drums associated with the RS-1 system.

It is anticipated that the interim system will be operational by 1 May 1999. The interim recovery system at RS-1 will continue to operate until the new remediation system is completed.

2.5 REMEDIATION SYSTEM EQUIPMENT IDENTIFICATION AND SPECIFICATIONS

The remediation system to be installed in the Tank Field, Line Leak, and Railroad Siding Areas will include three HVTPE blowers (one for the Line Leak Area, one for the Tank Field & Railroad Siding Areas, and one for the Railroad Siding Area). The HVTPE blowers will remove total fluids and soil vapors from designated extraction wells.

The remediation system recovery, separation, and treatment equipment will be housed in an equipment container located behind the Railroad Siding shed (**Figure 9**). All vapor-phase carbon units and the product recovery tank will be placed outside of the equipment container.

Recovered liquids and vapor from the Tank Field, Line Leak, and Railroad Siding Areas will be separated in the equipment container in a vapor/liquid separator tank. The total fluids stream will be directed through an oil/water separator, where recovered solvent will gravity-drain to a product recovery tank. The combined groundwater stream will be pumped from a holding tank through a groundwtaer treatment system for treatment via air stripping and liquid-phase carbon polishing. Treated groundwater will be discharged to an unnamed tributary of Valley Creek (permit pending). This discharge location is the same outfall point currently utilized for effluent discharge, as allowed by the existing NPDES Permit. Soil vapors from the air stripper off-gas will be directed to a vapor-phase carbon unit. All associated remediation equipment and piping is identified on the Piping and Instrumentation Diagrams (**Figure 4, 5, and 6**).

2.5.1 Soil Vapor Extraction and Groundwater Recovery Equipment

The principal components associated with the soil vapor extraction and groundwater recovery system are identified in **Table 2.1**.

Table 2.1
Soil Vapor Extraction and Groundwater Recovery Equipment Specifications

P&ID Tag	Item	Specifications
VLS-1,2,3	Vapor/liquid separators segregate recovered soil vapor stream from recovered total fluids stream	40 gallon w/ site tube, minimum, steel, 3" inlet/outlet, inc .vacuum relief valve, 30" Hg rated.
LRP-1	liquid ring pump for Railroad Siding Area	90 scfm @ 21 "Hg vacuum.
LRP-2	liquid ring pump for Railroad Siding/Tank Field Area	96 scfm @ 21 "Hg vacuum.
LRP-3	liquid ring pump for Line Leak Area	91 scfm @ 21 "Hg vacuum.
TP-1,2,3	the transfer pumps direct recovered total fluids from VLS-1,2,3 to OWS-1	6 to 12 gpm, 15 psi maximum.
VOS-1,2,3	the vapor/oil separators for each LRP skid (separates and reuses oil used for liquid sealing of each LRP)	Sized accordingly for each LRP.
HE-1,2,3	the heat exchangers cool recirculated oil for each LRP	Sized accordingly for each LRP.
F-1, 2, 3	the air filters remove fine particles from vapor stream before processing through LRPs	Rated for 300 cfm and 29" Hg vacuum.
OWS-1	the oil/water separator segregates recovered SPS from groundwater.	Rated for 20 gpm, gravity drain for oil and water, incl. coalescing plates.
HT-1	the holding tank allows groundwater which gravity drains from the oil/water separator to be stored for subsequent pumping through the groundwater treatment system.	200 gallon minimum w/ influent and effluent bulkhead fittings.
TP-4,5	the transfer pumps direct groundwater through the groundwater treatment system.	20 to 35 gpm, 50 psi maximum.

The proposed recovery compound consists of the following equipment operating parameters:

- The three proposed HVTPE blowers will be connected to a total of 31 HVTPE wells. LRP-1 will be connected to 8 wells in the Rail Road Siding Area, LRP-2 to 8 wells in the Rail Road Siding Area and 6 wells in the Tank Field Area, and LRP-3 to 10 wells in the Line Leak Area.

- A vapor/liquid separator tank will be installed prior to each vacuum blower to separate recovered water and solvent from the vapor stream. Each vapor/liquid separator will contain a high level probe which will disengage its respective vacuum blower when the tank is full.

- The solvent and water will be routed through a oil/water separator and then gravity fed into either a groundwater holding tank or a product recovery drum. The solvent/water separator segregates the SPS from the groundwater following the vacuum extraction process. The coalescing separator removes free and dispersed solvent droplets (20 microns and greater) from the recovered groundwater. Recovered SPS is directed into a solvent storage tank. If the product storage drum, oil/water separator, or transfer sump tank is full, high-level shut-off probes will shut down the transfer pumps from the vapor/oil separators (which then shuts down the vacuum blowers from high-liquid sensors).

- Groundwater will gravity drain from the oil/water separator to the holding tank. Two transfer pumps will direct the groundwater from the holding tank through the groundwater treatment system.

2.5.2 Groundwater Treatment Equipment

The principal components related to the groundwater treatment system are identified in **Table 2.2**.

Table 2.2
Groundwater Treatment Equipment Specifications

P&ID Tag	Item	Specifications
F-4,5	two particulate filters to remove suspended solids prior to air stripping	Rated for up to 100 psi, 2" inlet/outlet. 50 micron filters.
AS-1	the low-profile air stripper treats the influent groundwater stream with a TEX removal efficiency of >99%	Specified with an air/water ratio to obtain > 99% TEX removal efficiency. Designed for a 45 gpm flow rate.
B-1	the air stripper blower is utilized to move air through the air stripper, resulting in the transfer of dissolved solvent to the vapor stream	300 to 700 cfm, up to 20" water pressure.
TP-6,7	transfer pumps direct treated groundwater from the air stripper sump through two additional particulate filters and two liquid-phase carbon units	25 to 45 gpm, 50 psi maximum.
F-6,7	two particulate filters remove suspended solids that are created through the air stripping process prior to carbon treatment	Rated for up to 100 psi, 2" inlet/outlet. 50 micron filters.
LGAC-1,2	two liquid-phase carbon units (plumbed in series) are utilized to remove any dissolved solvents (with a removal efficiency >90% through each unit) that remain in the water stream following air stripping.	500-pound units minimum, rated for 25 to 45 gpm and at least 50 psi.

The groundwater treatment system treats recovered groundwater from each of the three areas. The proposed groundwater treatment compound consists of the following equipment operating parameters:

- A particulate filtration system will remove suspended solids from the recovered groundwater stream prior to the low-profile air stripper and prior to carbon treatment to prevent sediment accumulation in the air stripper and liquid-phase GACs.

- The groundwater treatment system will consist of a low-profile air stripper and two high-pressure liquid-phase GACs. These two treatment methods will be utilized in order to ensure that effluent TEX concentrations are within NPDES limitations.

2.5.3 Components to be Located Outside of the Equipment Container

The principal components to be located outside of the equipment container are identified in **Table 2.3**.

Table 2.3
Equipment Located Outside of the Equipment Container

P&ID Tag	Item	Specifications
VGAC-1,2	two vapor-phase carbon units will be utilized to treat the vapor stream from LRP-1	500-pound units minimum. Rated for 250-300 cfm.
VGAC-3,4	two vapor-phase carbon units will be utilized to treat the vapor stream from LRP-2	500-pound units minimum. Rated for 250-300 cfm.
VGAC-5,6	two vapor-phase carbon units will be utilized to treat the vapor stream from LRP-3	500-pound units minimum. Rated for 250-300 cfm.
VGAC-7	one vapor-phase carbon unit will be utilized to treat the air stripper off-gas vapor stream	500-pound units minimum. Rated for 300 – 700 cfm.
T-1	a product recovery tank with secondary containment (a sealed, vented, and grounded plastic over pack drum) will be utilized to contain recovered solvent that drains from the oil/water separator	Existing product recovery tank (55 gallons) with secondary-contained overpack.

2.6 REMEDIATION SYSTEM SUB-GRADE TRENCHING

The sub-grade trenching network will be installed as shown on the site plans **(Figure 1, 2, and 3)**. GES will subcontract all trenching, excavation, and backfilling work associated with the sub-grade piping installation.

GES will locate utility lines prior to construction via Pennsylvania One Call utility clearance and through Quebecor facility utility plans. GES and all subcontractors will exercise caution and schedule operations in advance to ensure that normal business activities at the facility will not be disrupted. Construction will be completed in phases to provide the least possible interference to Quebecor activities. GES will coordinate an orderly transfer of personnel and equipment to the facility.

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Secondary containment piping is not necessary on the influent HVTPE piping network since the principal of soil vapor and total fluid recovery is a vacuum process. Should a break occur in the influent piping network under the vacuum conditions, groundwater and soil vapor would not leave the piping network. Instead, ambient air would be drawn into the pipe and combine with the recovered vapors/total fluids for separation in the treatment system. Therefore, since the influent piping network could not pose a threat to leak untreated fluids, there is no reason to utilize secondary-containment piping.

2.7 REMEDIATION SYSTEM RECOVERY WELL INSTALLATION

A total of 24 new recovery wells will be installed to provide an aggressive recovery well network for HVTPE in the Railroad Siding, Line Leak, and Tank Field Areas; seven existing wells will also be used. The HVTPE recovery wells will be constructed of 4”-diameter schedule 40 polyvinyl chloride (PVC) piping for well casing and 4”-diameter schedule 40 PVC piping with 0.02-inch slots for well screen. The proposed locations for the new HVTPE recovery wells and tank field groundwater recovery sumps are shown on the site plan **(Figure 1 and 2)**.

Borehole advancement will be performed using a truck-mounted drill rig with an air-rotary methodology. Soil samples will be continuously cored from each boring using a split-spoon sampling device. Soil samples will be screened for VOCs with a hand-held organic vapor monitor (OVM). One soil sample will be collected from each of the soil borings for analysis of TEX by EPA Method 846 – 5035/8020A. Additional sampling details can be found in the Sampling and Analysis Plan.

Table 2.4 summarizes the existing wells that will be utilized as recovery wells and the new recovery wells that will be installed

Table 2.4
Summary of HVTPE Recovery Wells

	Tank Field Area	Railroad Siding Area	Line Leak Area
Existing wells/sumps to be utilized		MW-10, RW-2, RW-3, RW-4, S-3, and S-4	MW-21A
New recovery wells/ sumps to be installed	RW-24, RW-25, RW-26, RW-27, RW-28, RW-29	RW-5, RW-6, RW-7, RW-8, RW-9, RW-10, RW-11, RW-12, and RW-13	RW-14, RW-15, RW-16, RW-17, RW-18, RW-19, RW-20, RW-21, RW-22, and RW-23

Note: Removal of underground storage tanks, impacted soil, and back filling of the UST excavations was completed between the date of the Corrective Measures 50% Design Report (dated 29 April 1998) and the submittal of the Corrective Measures 90% Design Report. The following text accurately reflects the work already completed.

3.1 PRECLASSIFICATION OF SOIL

Prior to UST removal, (June 29 and 22 July 1998) GES utilized a Geoprobe® to collect soil samples from twenty different locations surrounding the two tank fields. The purpose of the samples were to further investigate the bounds of soil impact and complete the laboratory analysis necessary for waste disposal classification in advance of any excavation of soils in the Tankfield Area.

GES collected and analyzed the soil samples for waste disposal parameters and to gain pre-approval for waste disposal at an approved facility prior to the commencement of excavation. This process allowed excavated soils from the UST area to be loaded directly into dump trucks and transported offsite on the same day of excavation, thus eliminating the need to store hazardous soils in on-site roll-off containers.

A workplan to complete the above-described Geoprobe® activities, dated 22 June 1998 was submitted to USEPA for review and approval (see the Project Management Plan, dated February 4, 1999). The workplan was approved by USEPA and Geoprobe® soil sampling activities were completed on 29 June and 22 July 1998.

A detailed summary of the soil boring program, including graphical representations of analytical sampling results is included in the Corrective Measures Sampling and Analysis Plan.

3.2 UST REMOVAL

As stipulated in the 50% design report, UST removal was conducted in two phases:

- Underground storage tanks (USTs) and adjacent, impacted soils were removed in accordance with the Quebecor UST Removal Sampling Plan (dated 7 July 1994) and stipulations in the Site Sampling Plan (Section 3.8.2). Excavated soils not requiring off-site disposal were stockpiled on plastic sheeting near the excavations and soil samples were collected for laboratory analysis. Soils requiring off-site disposal were loaded directly into trucks for transportation to an approved hazardous waste disposal facility.
- Tanks were removed in two individual phases. Phase 1 entailed the removal of the four southern tanks. Soils impacted above Media Cleanup Standards were not encountered in the Southern Tank Field Area. Phase 2 entailed removal of the four northern tanks and impacted soil. Stockpiled soil containing concentrations of chemicals of concern below USEPA limits (as determined by laboratory analytical data) and as defined in correspondence from USEPA dated 13 November 1998, were utilized as backfill.

- An UST Closure Report in accordance with PADEP UST regulations was completed and filed with PADEP. A copy of the report was also submitted to USEPA.
- Proper disposal of all USTs was completed. UST disposal documentation was provided in the UST Closure Report.
- Soils impacted above Media Cleanup Standards were removed to ensure that impacted soils do not continue to impact groundwater. Approximately 700 tons of soil was removed. Manifests for all soil disposal were included with the UST Closure Report.
- Since not all impacted soil could be removed due to encroachment on adjacent buildings and roadways, limited areas of impacted soil remaining in place will be remediated via high-vacuum, total phase extraction (HVTPE).
- A design summary of the HVTPE system to remediate the dissolved chemicals of concern in groundwater and adsorbed chemicals in soils is included with this report.

A Pennsylvania-certified excavation contractor performed all UST excavation and removal activities. GES supervised and documented UST removal operations and visually inspect the integrity of each removed UST and all removed piping. No indications of structural damage (e.g., corrosion or pitting) were noted on any of the removed USTs. GES photographed the work site and removed USTs.

4.1 SITE SAFETY

A site-specific Health and Safety Plan (HASP) was developed to include all field activities associated with the Corrective Measure Implementation (CMI), in accordance with Occupational Safety and Health Administration guidelines (29 CFR 1910.120). The HASP will be reviewed and signed by all field personnel (GES or other) prior to conducting site work to ensure that all personnel and subcontractors understand health and safety requirements. The HASP includes material safety data sheets for all compounds that may be encountered during field activities, directions to the nearest hospital, and other pertinent safety information.

4.2 SUBCONTRACTOR PROCUREMENT

GES goes through a process of pre-qualifying subcontractors to ensure that the project is conducted with a high standard of quality. Prior to procurement, GES will competitively bid all subcontractor disciplines associated with the project. Subcontractors will meet all health and medical monitoring guidelines associated with OSHA 29 CFR 1910.120. Additionally, GES will require subcontractors to submit proof of insurance in accordance with GES standard subcontractor approval processes.

4.3 SUBCONTRACTOR MANAGEMENT

Implementation of corrective measure construction will follow the project-specific work schedule provided by GES. In addition, with a prior consensus on labor completion, subcontractor management will be greatly streamlined, and a cooperative working relationship will be maintained for the duration of the project.

GES's Construction Manager (CM) will be onsite daily to complete the following tasks:

- Complete health and safety "tailgate meetings" prior to work each morning,
- Discuss and confirm daily progress expectations with subcontractors,
- Discuss any unforeseen or additional work related needs, and make provisions to resolve them,
- Provide weekly updates to the client and discuss any major changes in scope with the client, as such situations arise,
- Communicate field activities to relevant facility personnel,
- Coordinate equipment receipt and handling, and
- Supervise all construction activities.

4.4 INSPECTIONS

GES will conduct a preconstruction inspection and meeting to review project specifications, equipment staging locations, and security and safety protocol. During construction, inspections will be conducted to confirm adherence to design specifications, health and safety compliance, and completeness of documentation.

4.5 PRE START-UP EQUIPMENT TESTING

Once the remediation system is installed and the electrical supply is properly connected, GES will begin a pre start-up test to inspect all system components and interlocks for proper operation. Potable water will be used to fully charge all water recovery and treatment devices, including filling the vapor/liquid separator, oil/water separator, the holding tank, and the liquid-phase carbon units. A 300-gallon sump will be filled with water outside of the compound to simulate groundwater in a well. A flexible hose will be attached to each LRP, individually, and will be placed within the sump. Each LRP will be tested individually. The groundwater discharge line will be directed into the holding tank so that the water within the 300-gallon sump is re-circulated. This will also allow the groundwater treatment system equipment, components, and interlocks to be tested along with the LRPs. The LRPs and each of the transfer pumps will be monitored to ensure that they operate as specified prior to pumping impacted groundwater.

4.6 REMEDIATION SYSTEM START-UP

At any given time, the system is designed to operate 11 of the 15 extraction wells in the Railroad Siding Area, 7 of the 10 extraction wells in the Line Leak Area, and 3 of the 6 extraction wells in the Tank Field Area. The net work of extraction wells, utilized at any specific time will be adjusted (or "pulsed") based on the system performance criteria. The general criteria assessed will include the following:

- Laboratory results of soil samples collected during the installation of new HVTPE wells.
- Influent vapor concentrations extracted from individual HVTPE wells, as monitored with a PID.
- Vacuum and flow data recorded at individual HVTPE wells.
- Influent vapor concentration collected from the combined influent of each LRP, as monitored with a PID.
- Monthly air bag samples (i.e., laboratory analysis samples) collected from the combined influent of each LRP.
- Results of quarterly and biannual groundwater monitoring events.

When individual wells or groups of wells show quantitative decreases in the extracted vapor concentration, GES will redirect remedial efforts toward other areas or wells thought to contain higher concentrations of chemicals of concern. Since system operations will be inspected and adjusted at least twice per month, this qualitative assessment of data to determine an effective pulsing schedule will be effective.

twice / week

4.6.1 Baseline Data Collection and Assessment Prior to System Operation

GES will review soil and groundwater sampling data collected during the installation of all proposed HVTPE wells (see **Section 2.0 of the Sampling and Analysis Plan**) and all historical site sampling data to determine the most impacted areas of the site. Prior to system operation, liquid-level data will be collected from each of the site monitoring/extraction wells. Evaluating the dissolved concentrations observed during historical sampling events and reviewing concentrations of chemicals of concern present in the soil samples collected during HVTPE well installation at each of the areas requiring remediation will assist in determining which wells to utilize upon system start-up. Initially, the wells located in areas where the highest dissolved concentrations of chemicals of concern are observed will be utilized as extraction wells.

Upon system start-up, LRP-1 will be started and extraction wells will be opened one at a time until the LRP reaches maximum air/liquid recovery potential. Since initial liquid recovery rate may be higher upon start-up, it may take time to dewater the soil sufficiently before increasing the number of extraction wells for that LRP. Once LRP-1 has been started and reaches its maximum number of extraction wells, GES will perform the same start-up procedures on LRP-2, then on LRP-3.

4.6.2 Periodic Data Collection Events During System Operation

When the system installation is completed and all of the system components are inspected and fully operational, GES will collect additional groundwater quality data from each of the individual compliance monitoring points, approximately every three months (See **Section 2.2.2 and 2.2.3 of the Sampling and Analysis Plan**). This groundwater quality information, combined with system effluent vapor concentration data, will allow GES to determine if changes in the extraction well configurations are beneficial.

Groundwater samples will be collected as noted:

Table 4.1
Summary of Compliance Monitoring Points

	Tank Field Area	Railroad Siding Area	Line Leak Area
Compliance Groundwater Sampling (Sampled first and third quarters)	RS-1, MW-3, MW-8, MW-9, RW-23, RW-28 RW-24 ?	MW-10, MW-12, RW-2, S-3	MW-21A
Expanded Compliance Groundwater Sampling (Sampled second and fourth quarters)	RS-1, MW-3, MW-8, MW-9, RW-23, RW-28 , RW 29 ?	MW-10, MW-12, RW-2, S-3, RW-3, RW-5, RW-9, RW-13	MW-21A, RW-14, RW-18, RW-21

MW 26, 27, ~~28~~

G

all RW wells inside the plume area

GES will also collect vapor samples for laboratory analysis from the influent (pre-treatment) vapor stream of each of the three LRPs on a Monthly basis. These samples will be analyzed for BTEX, C1-C4 Hydrocarbons, and >C4-C10 Hydrocarbons (See **Section 2.3.1 through 2.3.3 of the Sampling and Analysis Plan**)..

4.6.3 Biannual Groundwater Sampling of "Select" Onsite Wells

Select monitoring/extraction wells will be sampled on a biannual basis (See Table 4.1, above and **Section 2.2.2 and 2.2.3 of the Sampling and Analysis Plan**) to determine the effectiveness of the remediation system in select areas. The monitoring/extraction wells to be utilized are likely to change with each sampling event, depending on the results of the previous sampling event.

On site MW3, MW4, MW8, MW9, MW10, MW12, MW13, RW1, RW2, S-3

Upgradient [illegible] Pond [illegible]

The costs associated with corrective measure construction are summarized in **Table 5.1**.

Table 5.1
Estimated Construction Costs

Major Task	Sub-Task	Estimated Cost
System Construction	Soil Preclassification	$ 4,931
	Utility Mark-Out	$7,152
	Preconstruction Inspection Meeting	$7,424
	Southern Tank Field Removal & Roadway Construction	$ 47,900
	Northern Tank Field Removal	$ 48,518
	Well Installation	$ 46,500
	Equipment Procurement	$ 2,588
	Trenching Activities/System Piping	$ 98,000
	Wellhead Modifications	$ 7,200
	HVTPE Recovery & Treatment System	$ 126,672
	Groundwater Recovery System (Tank Field)	$ 14,450
	System Check	$ 3,048
	System Start-up	$ 3,092
	Site Survey	$ 2,503
	AWI Report	$5,958
	Coordination	$18,554
	Laboratory Analytical Costs	$17,550
	Electric Utility Costs	$5,000
	Waste Disposal Costs	$150,862
	Carbon Costs	$16,000
	TOTAL	**$ 633,902**

Corrective measure operation, maintenance, reporting, sampling, and monitoring have been estimated for budgetary purposes in **Table 5.2**.

Table 5.2
Estimated Costs During Corrective Measure Operation & Maintenance

Major Task	Sub-Task	Estimated Cost
System Operation & Maintenance	System O&M – Month 1	$ 4,336
	System O&M – Months 2 - 35	$ 75,740
	Quarterly Groundwater Sampling	$ 20,736
	Reports	$ 8,970
	Coordination	$ 10,528
	Laboratory Analytical Costs	$ 53,000
	Electric Utility Costs	108,000
	Waste Disposal Costs	$2,800
	Carbon Costs	$111,000
	TOTAL	**$ 395,110**

Additionally, system post-operational monitoring, reporting, and sampling costs have also been estimated. These costs are presented in **Table 5.3**.

Table 5.3
Estimated Costs During Post-Operational Monitoring

Major Task	Sub-Task	Estimated Cost
System Post-Operational Monitoring, Reporting, and Sampling	Quarterly Groundwater Sampling	$ 13,780
	Reports	$ 3,964
	Coordination	$ 10,252
	Contingency	$ 9,692
	Closure Report	$ 4,000
	Laboratory Analytical Costs	$32,500
	Electric Utility Costs	$6,000
	Waste Disposal Costs	$2,800
	Carbon Costs	$4,500
	TOTAL	**$ 86,488**

These estimated costs are based upon the conceptual design that has been described in Section 2.0.

System operation and maintenance (O&M) visits will maintain systems in proper working order, assist in determining various system operating parameters, as well as provide the necessary information to make system adjustments. HVTPE and groundwater recovery system operational parameters (applied vacuums, vapor flow rates, groundwater flow rates, straw lengths) will be monitored and adjusted for optimal performance. Performance of the vapor/liquid separator, transfer pumps, oil/water separator, air stripper, and vapor and liquid-phase GACs will be monitored closely to maximize system performance.

After the system installation is complete, site visits will occur on a weekly basis for the first month of system operation. At the close of the first month of operation and maintenance, site visits may be conducted twice per month to monitor the operating conditions of the remediation systems, fine-tune and maximize the operating efficiency of the system, and to collect groundwater and vapor treatment system compliance samples. System performance data will be recorded for reporting purposes.

All O&M activities shall be performed in accordance with standard operating procedures and health and safety guidelines. Data collection protocol (e.g., field notes and field instrument calibration) will adhere to the QAPjP, the Sampling and Analysis Plan, and the Data Management Plan. The O&M manual to be prepared prior to system activation will fully describe all remedial system O&M activities. The O&M manual will also document health and safety procedures associated with the tasks to be performed and will provide specific direction in response to these concerns.

6.1 NORMAL OPERATION AND MAINTENANCE

Routine maintenance activities will be conducted in order to obtain system performance data for system tracking, to adjust system operating parameters to maximize system operation, and to collect system samples for laboratory analysis. Routine maintenance activities will be conducted every two weeks.

Preventive maintenance activities will ensure that remediation system equipment operates efficiently and effectively. Preventive maintenance activities will include remediation system inspections and adjustments to minimize equipment problems by proactively observing system operating parameters. GES engineering department will evaluate potential problems by tracking system performance information such as flow rates, pressures, vacuums, motor amperage, and motor cycling.

GES field service personnel will perform preventive maintenance tasks during O&M visits to prevent system operational problems. These preventive maintenance tasks include inspecting remediation equipment (such as level probes, separators, and the air stripper) for fouling, changing filter cartridges as-needed, and periodically back-washing the liquid-phase GAC vessels.

Corrective maintenance activities include tasks associated with system troubleshooting and equipment servicing. Alarm conditions that will deactivate the remediation system will be connected to a data logging control panel with telemetry capabilities. Upon alarm condition activation, the telemetry unit will immediately notify GES. The system alarm will be investigated remotely via computer modem or telephone so that GES field service personnel will be informed of the problem prior to mobilization to the site. System down-time will be minimized since the telemetry unit will allow for a quick response to the alarm condition and because GES is located within 25 miles of Quebecor.

6.2 OPERATION AND MAINTENANCE MONITORING FREQUENCY

In order to maximize the operation of the remediation system, the above-referenced protocol will be performed on a routine basis. **Table 6.1** summarizes the maintenance and monitoring schedule that will allow for an effective maintenance program.

Table 6.1
Maintenance and Monitoring Schedule

<u>EVERY TWO WEEKS</u>

- Check system status and operation. If the system is down, determine the cause of system shut-down. Make system repairs as needed. Adjust drop tube, vacuums, and flow rates as instructed by engineering.
- Measure vapor stream solvent concentration with an organic vapor monitor (OVM) at the following locations: before each vapor-phase GAC; between vapor-phase GACs; and after GAC treatment (discharge to atmosphere).
- Measure air velocity at the locations that the vapor stream solvent concentration measurements were collected. This information is necessary in calculating the total mass of vapor-phase solvents recovered.
- Record groundwater totalizer readings and flow rate indicator readings during transfer pump cycling for each transfer pump. Also measure the rise of water in each vapor/liquid separator over time (while each transfer pump is off) so that the system influent (non-averaged) flow rate can be calculated.
- Record the values indicated by all system pressure and vacuum gauges.
- Inspect liquid-phase GAC and air stripper pressure readings to determine if units are fouling.
- Inspect and record the position of all valves on the vacuum side of the blowers.
- Collect system water samples after GAC treatment. Samples will be shipped to an EPA-approved laboratory for analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX). The effluent water sample will also be field analyzed for pH.
- Monitor all system faults and interlocks to ensure that they are operating properly.
- Replace groundwater particulate filter cartridges if necessary.

<u>MONTHLY</u>

- Inspect and clean all liquid-level sensors.
- Inspect system Y-strainers if necessary.
- Collect HVTPE system vapor samples in Tedlar bags before each primary GAC treatment (3 locations). Samples will be sent to an EPA-approved laboratory for analysis of BTEX by EPA Modified Method TO3. Hydrocarbon concentrations will be field-monitored with an Organic Vapor Meter (OVM) before each secondary GAC unit (3 locations), and after each secondary GAC unit (3 locations). Additionally, the air stripper off-gas will be monitored before and after carbon treatment with an OVM.
- Collect system water samples before the air stripper and GAC units and between and after GAC units. Samples will be shipped to an EPA-approved laboratory for analysis of BTEX.

<u>QUARTERLY</u>

- Collect groundwater samples from select site monitoring wells.
- Inspect solvent separator, vapor/liquid separators, air stripper, and totalizers for fouling. Clean if needed.
- Test all system faults and interlocks to ensure that they are operating properly. Testing all interlocks will ensure that the system will be deactivated upon system alarm conditions.

<u>AS NEEDED</u>

- Verify drop tube depths (i.e., suction/drop tubes) at HVTPE wells.
- Record drop tube and casing vacuums at HVTPE wells.
- Record valve positioning at HVTPE wells.

6.3 POTENTIAL OPERATION AND MAINTENANCE PROBLEMS AND COMMON REMEDIES

Data obtained during the operation of the existing system was evaluated to provide an effective conceptual design and a reliable remediation system. The GES approach includes the following:

- The low-profile air stripper utilized for groundwater treatment is less sensitive to fouling problems than packed-tower air strippers and is also easier to clean and maintain routinely.
- The specified transfer pumps are less sensitive with pressure changes than typical transfer pumps. The selected pumps were chosen to direct the water stream through high-pressure carbon units since the corresponding flow rate does not significantly change as the pressure increases.
- High pressure liquid-phase carbon units are proposed so that groundwater from the air stripper may continue to be pumped at the design flow rate even after particulate/sediment loading causes high pressure to develop in the GAC vessels. Low-pressure carbon treatment units are limited to 10 to 12 psi pressure, which dramatically reduces the effluent flow rate as pressure builds up in the units. Additionally, water that is pumped at higher flow rates through carbon units will not foul the carbon units as much as pumping water under lower pressures.
- The liquid/vapor separator tanks, transfer sump, air stripper, and filtration units that were selected in the conceptual design allow for easy inspections and cleaning.
- The telemetry package for the remediation system will relay alarm conditions as soon as they occur and data-log system performance so that system problems are identified before they occur. The use of a telemetry system will dramatically assist in maintaining a reliable system.
- The operation and maintenance schedule provided in the proposal text details the routine cleaning of system components which will prevent excessive fouling of system components.
- Redundancy in transfer pump operation has been built into the system at the holding tank through filtration and air stripping and at the air stripper sump through filtration and liquid-phase carbon treatment. The transfer pump redundancy is comprised of a back-up transfer pump (at both locations) which is connected parallel to the main transfer pump. If the main transfer pump can not remove groundwater at the required rate, the back-up transfer pump will operate. The transfer pump redundancy will also allow the system to continue to operate when the main transfer pump is being repaired or cleaned.

6.4 DESCRIPTION OF ALTERNATIVE OPERATION AND MAINTENTANCE

Remediation system equipment and components will be controlled and operated by main control panels. Should any of the remediation system equipment or components remediation system fail, various system alarm conditions will be interlocked to the system control panels to deactivate other operating equipment to prevent a hazard from occurring. Additionally, the system alarm conditions will notify GES personnel upon occurrence via a telemetry system built into system controls. System alarm conditions and the associated interlocked equipment are summarized in **Table 6.2**.

Table 6.2
System Alarm Conditions

Interlock #	P&ID Switch ID	Alarm Description	Equipment Interlocked To The Alarm Condition
I_1	LSHH-100	High-high level in vapor/liquid separator VLS-1 of LRP-1 skid. This high-high level sensor will shut down its respective LRP to prevent water from being pumped through the LRP. Water being pumped through the LRP may cause serious damage.	Liquid ring pump LRP-1
I_2	TSH-100	High temperature on effluent of LRP-1. This temperature switch, which indicates a high oil temperature, will shut down its' respective LRP. A high oil temperature could cause serious pump damage as well as excessively burn oil.	Liquid ring pump LRP-1
I_3	LSL-100	Low oil in vapor/oil separator VOS-1 of LRP-1 skid. This oil level switch will shut down its' respective LRP to prevent pump damage. The oil is used to create a seal in the LRP, which allows the high vacuum to be applied.	Liquid ring pump LRP-1
I_4	LSHH-200	High-high level in vapor/liquid separator VLS-2 of LRP-2 skid. This high-high level sensor will shut down its' respective LRP to prevent water from being pumped through the LRP. Water being pumped through the LRP may cause serious damage.	Liquid ring pump LRP-2
I_5	TSH-200	High temperature on effluent of LRP-2. This temperature switch, which indicates a high oil temperature, will shut down its' respective LRP. A high oil temperature could cause serious pump damage as well as excessively burn oil.	Liquid ring pump LRP-2
I_6	LSL-210	Low oil in vapor/oil separator VOS-2 of LRP-2 skid. This oil level switch will shut down its' respective LRP to prevent pump damage. The oil is used to create a seal in the LRP, which allows the high vacuum to be applied.	Liquid ring pump LRP-2
I_7	LSHH-300	High-high level in vapor/liquid separator VLS-3 of LRP-3 skid. This high-high level sensor will shut down its' respective LRP to prevent water from being pumped through the LRP. Water being pumped through the LRP may cause serious damage.	Liquid ring pump LRP-3
I_8	TSH-300	High temperature on effluent of LRP-3. This temperature switch, which indicates a high oil temperature, will shut down its' respective LRP. A high oil temperature could cause serious pump damage as well as excessively burn oil.	Liquid ring pump LRP-3
I_9	LSL-310	Low oil in vapor/oil separator VOS-3 of LRP-3 skid. This oil level switch will shut down its' respective LRP to prevent pump damage. The oil is used to create a seal in the LRP, which allows the high vacuum to be applied.	Liquid ring pump LRP-3
I_{10}	LSH-400	High level in oil/water separator OWS-1. This alarm will deactivate transfer pumps TP-1, TP-2, and TP-3. A high level in the oil/water separator will deactivate the treatment system to prevent overfilling of the separator.	Transfer pumps TP-1, TP-2, and TP-3
I_{11}	LSH-410	High level in product tank T-1. This alarm will deactivate transfer pumps TP-1, TP-2, and TP-3. A high level in the product tank will deactivate the treatment system to prevent overfilling of the tank.	Transfer pumps TP-1, TP-2, and TP-3
I_{12}	LSHH-400	High level in holding tank HT-1. This alarm will deactivate transfer pumps TP-1, TP-2, and TP-3. A high level in the holding tank will deactivate the treatment system to prevent overfilling of the tank.	Transfer pumps TP-1, TP-2, and TP-3
I_{13}	LSHH-410	High level in air stripper AS-1 sump. This alarm will deactivate transfer pumps TP-4 and TP-5. A high level in the air stripper sump will deactivate the treatment system to prevent overfilling of the sump.	Transfer pumps TP-4 and TP-5
I_{14}	PSH-400/ PSL-400	High & low pressure on air stripper blower B-1 inlet. These pressure switches will deactivate the groundwater recovery system (TP-4 and TP-5). A high pressure switch would indicate a clogged air stripper which may result in low air delivery through the stripper and reduced treatment efficiency. A low pressure switch would indicate a vapor leak in the air stripper, resulting in a reduced treatment efficiency.	Transfer pumps TP-4 and TP-5, and air stripper blower B-1

Note: Interlock and P&ID switch identification ID numbers are shown on the Piping & Instrumentation Diagrams **(Figures 5 and 6).**

Since GES is located in close proximity to the Quebecor facility, GES personnel will be able to respond to system alarm conditions in a timely manner, minimizing system down-time. Additional measures specified in Section 6.4 will allow for flexibility in system operation, resulting in additional back-up or redundant procedures to enable the system to stay operational.

6.5 MECHANISMS FOR KEEPING RECORDS AND REPORTING

The progress of the remediation system will be monitored closely to evaluate the progress of the system in the three areas of concern and to determine the optimal operational strategy. Groundwater quality will be monitored at select site monitoring wells on a quarterly basis so that the effects of the system can be evaluated. Should certain monitoring wells indicate decreasing dissolved solvent concentrations (indicating the effects of the remediation system), the applied vacuums to surrounding system extraction wells may be temporarily rerouted so that more impacted areas can be aggressively remediated. Conversely, should other monitoring wells indicate consistent or increased dissolved solvent concentrations, GES would attempt to more effectively remediate these areas by utilizing extraction wells in the vicinity of the impacted wells.

As well as evaluating dissolved solvent concentrations in site monitoring wells, GES engineers will track remediation system operating parameters (system influent concentrations, applied vacuums at extraction wells, air/water flow rates, and "straw" lengths) to determine which extraction wells should be utilized during each month of system operation. GES will prepare a site-specific system operation and maintenance inspection checklist for the 90% Design to ensure that the proper information is obtained during each system inspection.

6.5.1 PADEP UST Closure Report

GES has completed and submitted an UST Closure Report in accordance with PADEP UST regulations. The site-specific UST Closure report was submitted to USEPA and PADEP, and is dated 31 December 1998.

6.5.2 Progress Reports

Reports summarizing ACO-related activities will be submitted to the appropriate regulatory agencies following Quebecor's review and approval. These reports will be submitted on a quarterly basis during the first six months of system operation, followed by biannual reports throughout the system operation and post-operational monitoring activities. Included in these quarterly reports will be the following

- Description of work performed during the quarter,
- Estimate of CMI completed,
- Summary of findings to date,
- Description of any changes made to the CMI during the quarter,
- Summary of all contacts with representative of the local community, public interest groups, or the State government,
- Assessment of system performance, any system problems and solutions to correct the problems,
- Changes in project personnel,
- Projection of the work to be conducted in the next quarter, and

- Results of sampling and testing activities.

This task will be a continuation of the quarterly progress reporting which GES has conducted for this project since 1991.

6.5.3 CMI Report

At the completion of the corrective measure construction, GES will prepare a comprehensive CMI Report. The CMI Report will provide a synopsis of the corrective measure constructed for each area, an explanation of any modifications to the EPA-approved construction/design plans, and a listing of criteria that will be used to evaluate the effectiveness of the operating system. GES will include an evaluation of the anticipated performance of the corrective measures.

6.5.4 Semi-annual O&M Assessment Reports

GES will prepare semi-annual assessment operation and maintenance reports during the operation of the corrective measure systems. These reports will summarize system monitoring data and provide a detailed evaluation of system performance. The reports will include well gauging data and groundwater gradient map; sampling summary table; cumulative SPS and vapor-phase solvent removal data; and analytical reports of soil, vapor, and groundwater sampling. The reports will document remedial system effectiveness and groundwater quality improvement at the site. Concentrations of chemicals of concern in soil and groundwater will be graphically depicted on isoconcentration maps. Progress towards attainment of the remediation goals will be statistically evaluated. Semi-annual reports will also be prepared during the post-operational monitoring period.

7.1 CORRECTIVE MEASURE PERMITTING

7.1.1 Groundwater Discharge Permit

Permission will be requested from the PADEP to modify the existing site NPDES permit. Effluent discharge is proposed at the existing fallout location; however, the flow rate will need to be modified.

7.1.2 Air Discharge Permit

An air discharge application (Request for Determination of Requirement for Plan Approval) will be prepared by GES for PADEP approval. The air discharge application will allow for the discharge of treated soil vapors to the atmosphere. Vapor-phase carbon removal efficiency will be monitored on a monthly basis to assure that the carbon units are treating recovered soil vapors in accordance with discharge limits set by the PADEP. Monthly influent vapor samples will be collected from each of the three LPR units to calculate TEX recovery rates and to estimate carbon usage rates. The monthly influent samples will be analyzed for TEX, C1-C4 hydrocarbons, and >C4-C10 hydrocarbons. The carbon midfluent and effluent vapor streams will be monitored monthly with an OVM to further verify vapor-phase GAC efficiency. The air stripper off-gas (before and after GAC treatment) will also be monitored monthly with an OVM.

7.2 CORRECTIVE MEASURE SAMPLING

7.2.1 Remediation System Sampling

Remedial system groundwater compliance samples will be collected and analyzed in accordance with NPDES discharge requirements. Vapor samples will be collected in accordance with air discharge requirements provided by the PADEP. More detailed sampling information is contained in the Sampling and Analysis Plan. Anticipated compliance monitoring activities are summarized below:

- Collect remedial system groundwater samples on a monthly basis (assuming NPDES requirements will be monthly) in accordance with the NPDES permit at the following locations: pre-air stripper, post-air stripper (pre-carbon), carbon mid-treatment, and sewer discharge (post-carbon). Sample collection procedures will be conducted in accordance with the QAPjP.
- Effluent water samples will be submitted to a Quebecor-approved laboratory for analysis of BTEX via EPA Method 602 (or equivalent) in fulfillment of NPDES discharge requirements. Samples will also be collected before the first GAC and between the GAC units to determine removal efficiency and to calculate the carbon usage rate. GES will measure the pH of the effluent water stream on the frequency identified in the NPDES application.
- GES will collect vapor samples monthly from the influent to the vapor-phase GACs for laboratory analysis of BTEX, C1-C4 hydrocarbons, and >C4-C10 hydrocarbons. Carbon midfluent and effluent samples will be analyzed in the field via an OVM. The air stripper off-gas (before and after GAC treatment) will also be monitored monthly with an OVM.

- GES shall prepare and submit NPDES Discharge Monitoring Reports (DMRs) to Quebecor and appropriate regulatory agencies on a monthly basis.

7.2.2 Quarterly Sampling During Corrective Measures

GES will provide quarterly groundwater monitoring and sampling of select on-site monitoring wells while the remedial system is operative. A quarterly sampling frequency is proposed to provide sufficient monitoring data for remediation system performance evaluation. Groundwater samples will be collected in accordance with standard operating procedures and quality assurance/quality control protocol, as detailed in the Sampling and Analysis Plan. As currently proposed, groundwater samples will be collected per the following schedule:

Table 7.1
Summary of Compliance Monitoring Points

	Tank Field Area	Railroad Siding Area	Line Leak Area
Compliance Groundwater Sampling (Sampled first and third quarters)	RS-1, MW-3, MW-8, MW-9, RW-23, RW-28	MW-10, MW-12, RW-2, S-3	MW-21A
Expanded Compliance Groundwater Sampling (Sampled second and fourth quarters)	RS-1, MW-3, MW-8, MW-9, RW-23, RW-28	MW-10, MW-12, RW-2, S-3, RW-3, RW-5, RW-9, RW-13	MW-21A, RW-14, RW-18, RW-21